

Cross-cutting Interoperability in an Earth Science Collaboratory

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The Situation Today

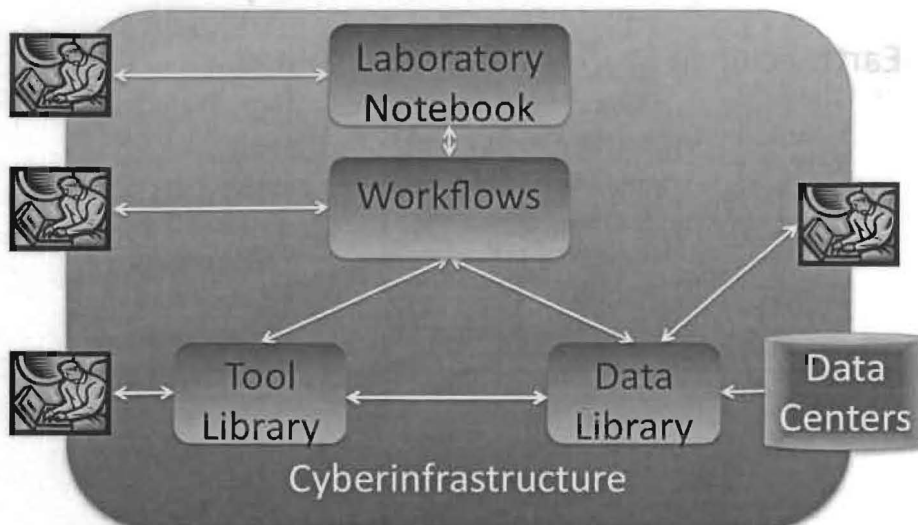
Earth Science Stuff is (still) hard to use...

- | | |
|----------------------|------------------------|
| data | find |
| science tools / svcs | share |
| analysis results | reuse |
| knowledge about | put together |
| • data | • data + data |
| • tools | • data + tool |
| • analysis methods | • tool + tool |
| | • desktop + online svc |

What Is An Earth Science Collaboratory?

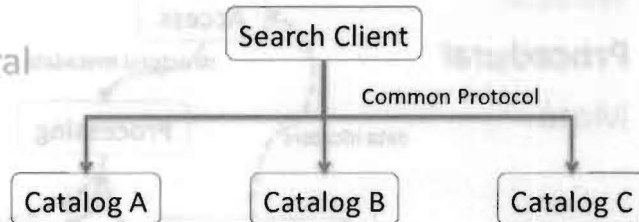
- A rich data analysis environment with:
 - Access to a wide spectrum of Earth Science data
 - A diverse set of science analysis services and tools
 - A means to collaborate on data, tools and analysis
 - ***Supports sharing of data, tools, results and knowledge***

Earth Science Collaboratory



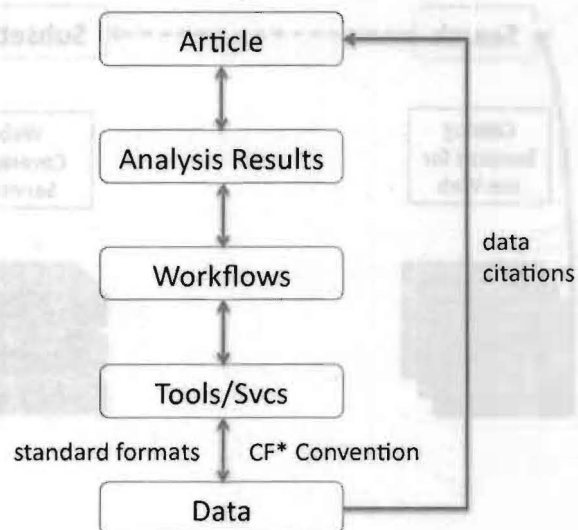
Types of Interoperability

- Horizontal
- Vertical
- Procedural
- Meta

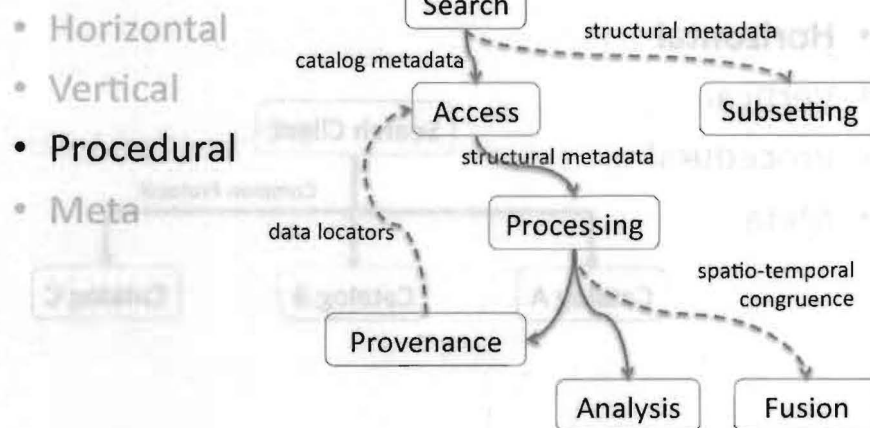


Types of Interoperability

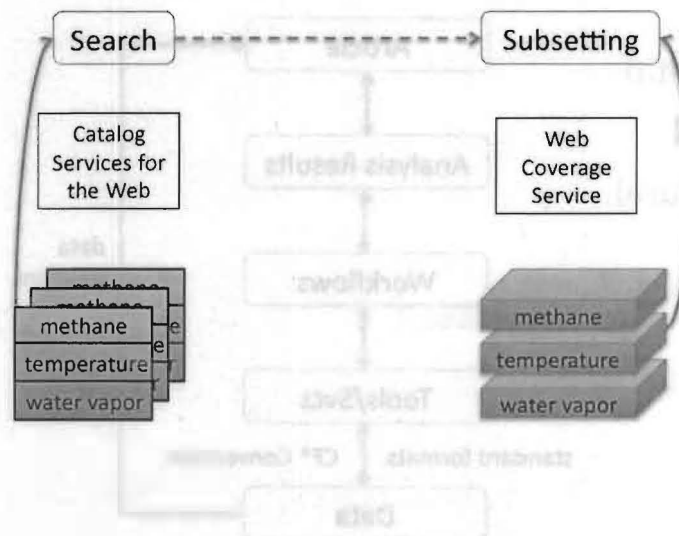
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Types of Interoperability



Procedural Interoperability Challenge



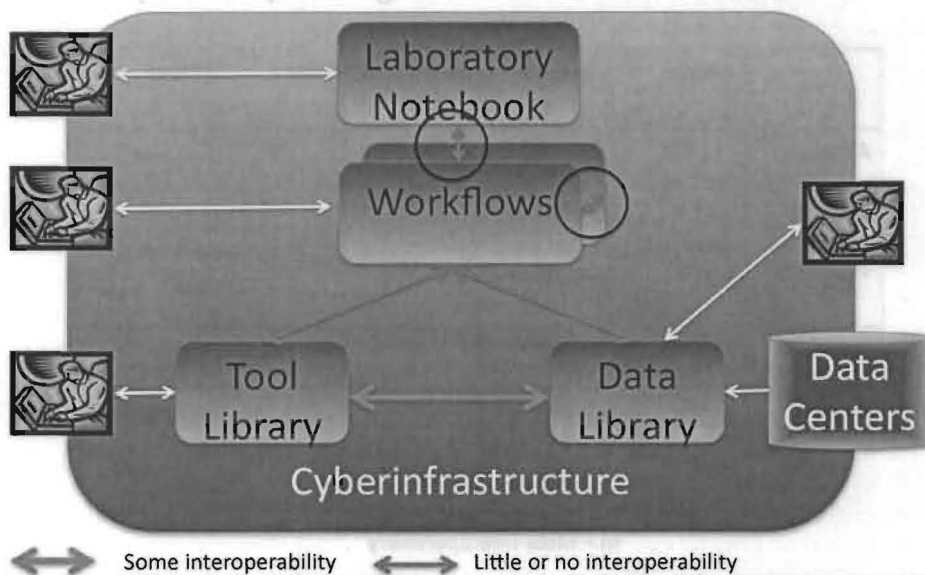
Types of Interoperability

Horizontal
Vertical
Procedural

- Meta

Procedure	Framework	Framework	Meta-Interop
Search	OGC Catalog Services for the Web	OpenSearch	Envelopment
Access	OGC Web Coverage Service	Data Access Protocol (OPeNDAP)	Gateways, Profile
Analysis	CF/netCDF	GIS formats	Profile?
Provenance	Open Provenance Model	Proof Markup Language	??
Model-Data "Fusion"	Data regridding	Model resampling	??

ESC Interoperability Status



Cross-Cutting Interoperability Strategies for Legacy Standards

Strategy	Interoperability Addressed	Example	Achilles' Heel
Client plug-ins	Procedural: Search-access-analysis	Environmental Data Connector for ArcGIS	Scalability
Omnivorous APIs	Meta: standard formats	netCDF-Java API, reads (some) HDF	Adoption
Gateways	Meta: OPeNDAP + OGC	OPeNDAP + WCS	Performance
Multi-lingual Servers	Meta: OPeNDAP + OGC	THREDDS Data Server, ERDDAP	?
Standards Convergence	Meta: standard formats	netCDF4 + HDF5	Scope, Cost
"Microformats"	Vertical	Data citations, esp. w/DOI	Adoption, Identifiers

We need standards for higher levels in the information stack to enable cross-cutting interoperability

	Article	Results	Workflow	Tool	Data
Article	M	V	V	V	V
Results	V	H	V	V	
Workflow	V	V	M	V	
Tool	V	V	V	H	
Data	V				H, M

H = Horizontal Interoperability
V = Vertical Interoperability
M = Meta-Interoperability

Lessons for Standards Engineering?

- Go beyond horizontal interoperability: consider implications for vertical and procedural interoperability
- Incorporate both syntax AND semantics
- Leverage microformats
- Embrace the Open World Assumption